

Smart Waste Management Using Lora

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ABSTRACT

Normally one of the challenging issues faced by the municipality is waste collection within city. Internet of Things(IoT) is not always practical since it requires internet connectivity. This can be solved by using Long range communication techniques such as LoRa. For the implementation of a proper waste disposal procedure, the presented solution provides a calculation of more efficient garbage truck routes. It offers a luxury through which the city service providers can use communication technologies to engage with the people to create a better livelihood and systems that can improve the quality of life. As for the output, we do a set of experimental simulation focused on the mentioned area. If dustbin is filled we get an alert via SMS to an authorized person in a particular time and through image processing segregation of wastes is also done. This paper will explore the smart waste management concept and propose a strategy development model for the implementation of IoT systems in a smart city.

Keywords: Smart Waste Management, Internet of Things, LoRa, Image Processing, Smart City.

I. INTRODUCTION

The Smart City is one of the futuristic goals for any city in terms of providing a better livelihood. And proper waste management is one of the very important aspects that need to be properly managed to achieve this goal. Considering this situation, the countries around the world and also private companies are investing every year a significant amount of their budgets for the purpose of research, development and implementation of the concept of Smart City. The Internet of Things (IoT) is one of the majorly used communication infrastructure for smart cities and it plays a vital role for smart waste management, enabling interaction between machines or with humans, where information or data can be shared and used in a secure and smart way. With the use of IoT lively update of the trash cans can be kept an eye.

The use of IoT may prove to be a problem in rural areas. This can be overcome by the use of LoRa (Long Range)

Communication techniques which can function without the service of an internet connection and it can be particularly used in Smart waste management for purposes like intimating authorized persons to get rid of any filled trash cans.

Another important process is segregation of wastes such as normal and electronic wastes. This is done through Image processing and thus the wastes are segregated. With the ever increasing population there is an absolute necessity for maintaining a clean and hygiene environment. In most of the places the flooding of garbage bins is creating an unhygienic environment. This will further lead to a rise of different types of diseases and illness. This will affect the standard of living. To overcome these situations an efficient smart garbage management method was developed [1]. From the next year in Russia, a new system of solid municipal waste (SMW) management will start operating which will be the result of a deep reform of the industry. The new process makes an assumption of significant increase in the volumes of separate collection and segregating of the wastes, which will reduce its disposal at landfills. The reform will result in a significant improvement in the domestic waste management, especially in rural areas and the private sector around large cities suffering from illegal refuse dumps [2]. Every day the waste produced is getting increased. Even developing cities are still lagging behind in the area of waste management, particularly in the collection of garbage within the cities. Because of this, waste is getting piled up in certain areas. This not only poses a health risk to the environment, but also creates unpleasant livelihood for the residents. Thus a smart garbage monitoring system is therefore proposed to tackle the issues faced [3].

In today's world, time is of absolute essence which can't be managed by keeping track of each and every thing happening around with our tight schedule. So nowadays Automatic systems are being preferred rather than manual system, which makes our life more simpler and easier in every aspect. To make it a huge success IoT is the latest internet technology that has been developed. The number of internet users has increased exponentially that it has become a necessary part of our daily life [4]. Solid waste management is one of the major problems that India faces irrespective of the case of developed or developing states. It is seen that most of the garbage cans along the roadside get flooded because the waste is not collected in an efficient manner. It creates unhygienic condition for the people and spreads a foul smell around the surroundings. This leads in spreading many deadly diseases and illness. Most of the time wet and dry wastes are not segregated. Thus proper composting, recycling, incineration or any other processes cannot be applied to these wastes [5].

II. PROPOSED METHODOLOGY

As we saw there are many disadvantages in the existing system. So we are going to modify those in order to make it as an advantage. Our paper mainly consists of one dustbin, servomotor, ultrasonic sensor and microcontroller. First we train the model about bio and non bio degradable wastes. This is done by open cv image processing. A camera is used to capture the images of wastes. Then if you place any waste in the top of the dustbin, a servomotor rotates the top according to the wastes either to right or left. When the dust bin is full ultrasonic sensor detects and sends the information to the microcontroller and then the microcontroller transmits the signal to the head office using Lora technology. So whenever the dustbins are full it is automatically detected by the system and the entire data about the fullness of dustbins in that area is known, We can able to direct the garbage vans to collect the garbage more effectively. If you consider for many areas the information about the garbage bins, the live report can be found use our mobile.

III. BLOCK DIAGRAM

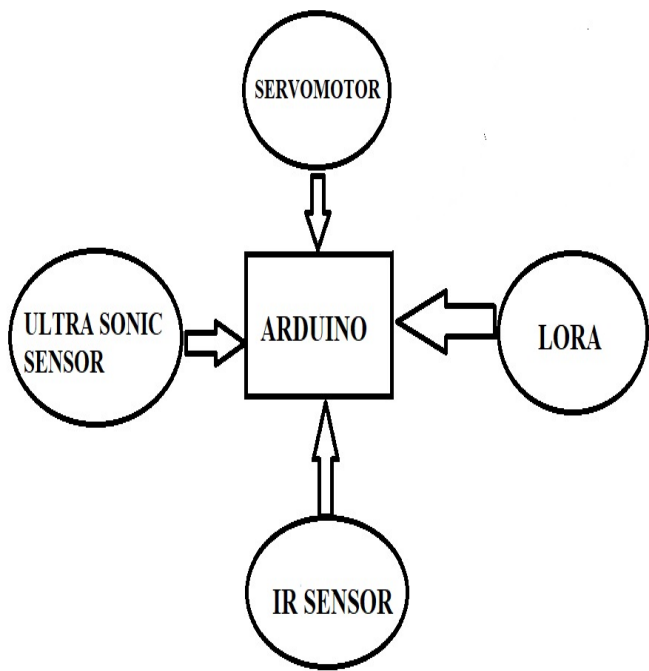


Fig. 1. Garbage can setup

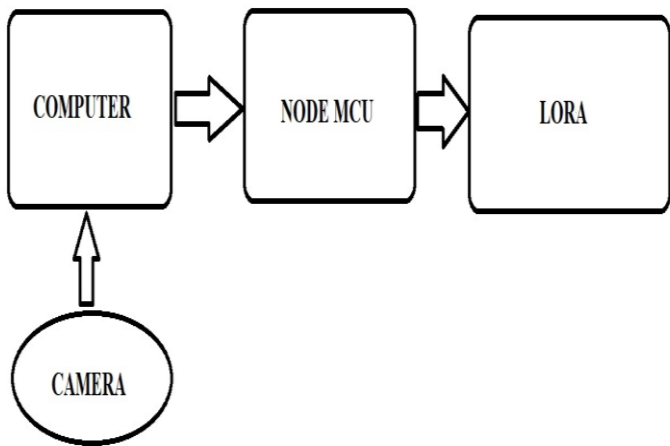


Fig. 2. Product detection setup

Internet of Things

The Internet of things (IoT) is the system of appliances, for example, vehicles, gardens and home apparatuses that contain hardware, programming, actuators, sensors and availability which enables these gadgets to linkup, connect and trade data. In our project Node MCU is connected with mqtt which sends the data. From this we can able to connect the mobile phone to mqtt and thereby we can receive the data whether the garbage can is fill or not. Due to the advancement of multiple technologies such as machine learning, embedded system, real-time analytics all contributes in enabling Internet of Things.



Fig. 3. Internet of Things

LoRa

LoRa WAN is a low power wide area network technology (LP-WAN) which is specifically used for Internet of Things (IoT) and smart sensor gadgets. As the name signifies, long range transmission capacity with less power consumption it makes use of. In our paper LoRa is connected to node mcu which transmits the data (i.e bio ornon bio degradable wastes) to the another LoRa which is connected to the Arduino. LoRa a big player in IoT networks. In LoRa technology, a message transmitted by any device is often received by single or multiple gateways. The received messages are going to be forwarded to the central network for processing.

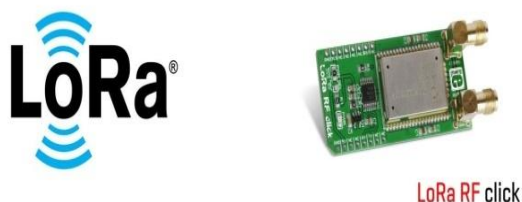


Fig. 4. LoRa

Ultrasonic Sensor

These are the sensors that use ultra sonic waves to detect the object at particular distance. The sensor at first emits an ultrasonic wave and it receives the wave that is reflected back from the target. They measure the distance to the target by measuring the time that takes between the emission and reception of the Ultrasonic Wave. In our project this sensor is used to detect the level of waste in the particular garbage can. This sensor is directly connected with the Arduino to collect the data. In a reflective model of the sensor, a single oscillator is used for emitting and receiving ultrasonic waves one after the another. This results in reduction of the sensor head. The device has two eye like projection in the front which are the Ultrasonic transmitter and Receiver.

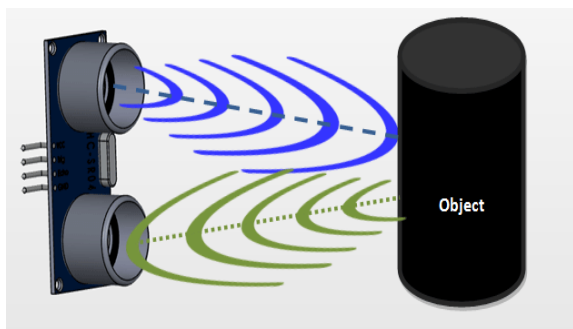


Fig. 5. Ultrasonic Sensor

NodeMCU

It is an open source firmware in which open source prototyping board designs are available. The term "NodeMCU" is an combination of "node" and "MCU" (micro-controller unit). In our project, this microcontroller unit is used to connect with IOT, LoRa, and computer. This microcontroller collects the data from the computer in a particular port and sends to both IOT and LoRa. It is one of the open source software and hardware development environment that is built for a very moderate expensive System-on-a-Chip (SoC) called the ESP8266. It is a low cost open source for IoT platform.

Camera

We use mobile camera which can capture images and send those images to the laptop for image processing for the segregation of the wastes.



Fig. 6 Camera

Servomotor

This servomotor can rotate in both clockwise and anti-clockwise directions based on the signal given by the microcontroller. When it rotates clockwise, it tilts the top plate towards right side. When it rotates anti-clockwise, it tilts the top plate towards left side. In our project, this motor is used to turn the top plate based on the control of Arduino which is already connected to it.



Fig. 7. Servomotor

Infrared Sensor

IR sensor is an electronic device that is used for the process of emitting and detection of IR radiation in order to find out certain objects/obstacles/disturbances within its range. In our project, this sensor is used to detect whether a object is placed in the garbage can or not. This sensor is also directly connected to Arduino to get the data. IR sensors use infrared radiation of wavelengths which falls between visible and microwave regions of electromagnetic spectrum. Infrared spectrum is divided into three regions depending on its wavelength



Fig. 8. Infrared Sensor

Arduino

The Arduino Integrated Development Environment-or Arduino Software (IDE) - it consists of an text editor used for writing some code, also a message area, a text console and a toolbar with buttons for the plenty functions and a series of menus. It connects to the Arduino and Genuino hardware where it is used to upload programs and thus helping to communicate with them.



Fig. 9. Arduino

IV. EXPERIMENTAL RESULT

When we have keep the waste it can segregate the wastes and the status of how much the bin is filled is given through Image processing, IoT and LoRa. Results with accuracy has been given below for the reference

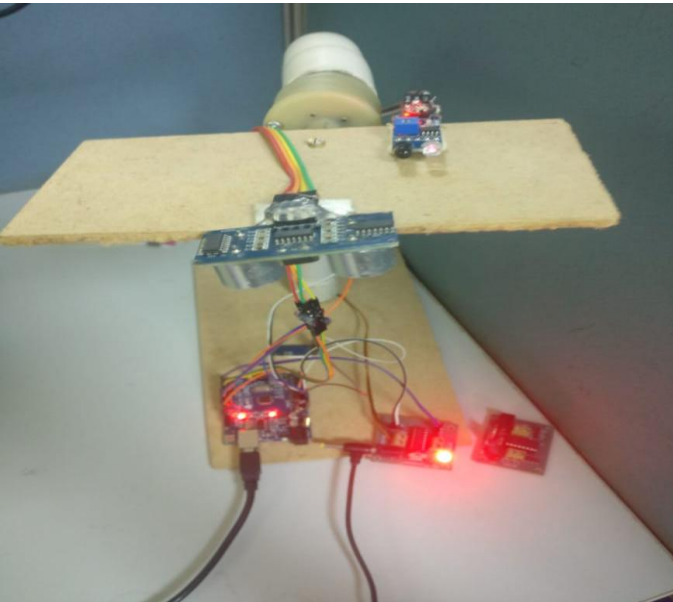


Fig. 10. Experimental Setup

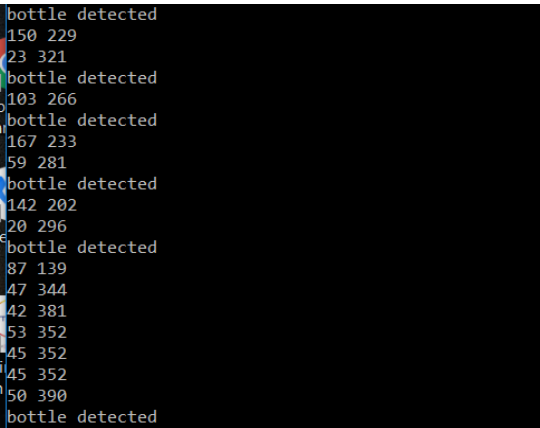


Fig. 11. Experimental Output

V. CONCLUSION

The main purpose of this paper is to demonstrate the importance of keeping the surrounding environment clean and hygiene by efficiently handling the wastes by means of technology and thus facilitating with proper waste disposal techniques in a way that is beneficial for everyone.

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